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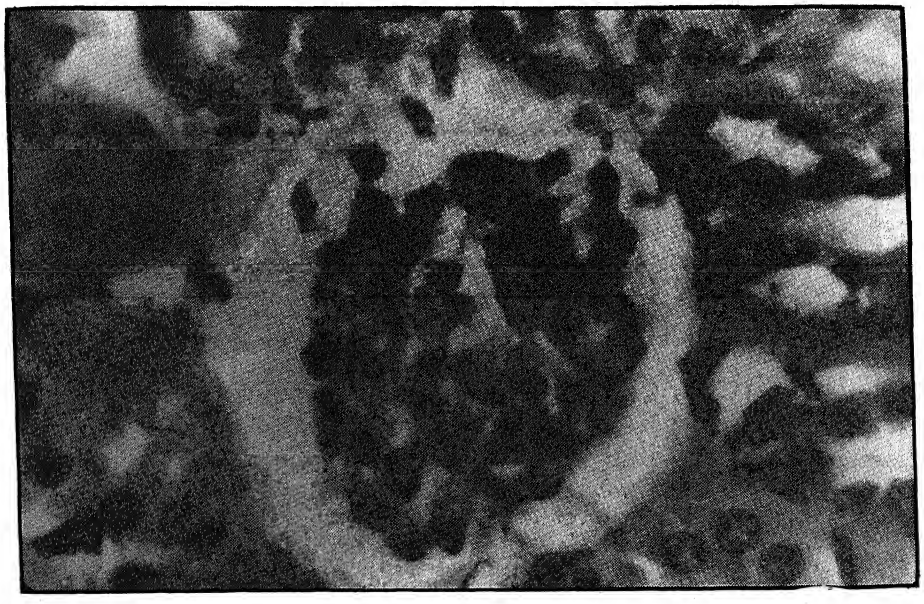

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Effect of apple pomace addition on the characteristics of bread and leavening activity of yeast

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Abstract Apple pomace substituted bread was evaulated with respect to the changes in different characteristics. Addition of apple pomace powder decreased the loaf volume and increased loaf weight, water absorption, crust brown colour and hardened its texture. Fermentation of dough substituted with apple pomace at 10 to 50% decreased loaf volume when compared to control. The results on the leavening activity revealed that pectin was responsible to decrease the leavening activity in dough fortified with apple pomace. Addition of yeast extract (0.1%) to the dough fortified with apple pomace (10%) marginally enhanced the leavening activity.

(**Keywords :** apple pomace/leavening activity/ bread/yeast)

Apple, a delicious temperate fruit grown throughout the world is largely used for table purpose though a significant quantity is processed into different products viz., apple juice, concentrate, canned slices, cider and wine[1,2,3,4,5]. After juice extraction, the apple pomace is left as a by-product, which is a serious problem of the apple processing industry. Since the pomace is high in Biochemical Oxygen Demand (B.O.D.) and its disposal into the environment causes serious pollution problem[6], therefore, measures to prevent the same are urgently needed.

Lack of dietary fibres in the diet of modern society has been associated with constipation, diverticulosis, cardiovascular diseases and cancer[9]. Recently, the role of crude fibres in protection against diseases has been reviewed[8]. Many forms of dietary fibres have been incorporated into bread. Pomerange *et al.*[9] replaced wheat floor upto 15% with cellulose in bread making[10]. Bread with apple fibres has also been tried[11]. Addition of apple fibres and cellulose on physical properties of the wheat flour has been reported[11]. How the apple pomace and its incorporation in the flour effects subsequently the bread preparation process is apparently not known yet. One of the pre-requisite of the bread making is the effective leavening activity resulting in the formation of CO_2 which gives the charac-

teristic spongey/porous character to the bread. It could either be carried out by yeast or chemicals, though the former is preferred due to the desirable flavour imparted to the bread. Apple fruit is also known to contain polyphenols or similar compound which may effect the activity of yeast during leavening[2,3]. Lack of published information on the effect of leavening activity of yeast in the dough fortified with apple pomace prompted us to conduct these experiments. Effect of addition of apple pomace with or without additives on the leavening activity in the pomace fortified dough and the characteristics of the bread produced was studied and the results obtained are reported in this paper.

Apple pomace : Apple pomace (mixed varieties) was collected directly from hpmc apple juice concentrate plant, at Parwanoo (HP). It was transported immediately to the laboratory at Nauni, Solan. The pomace was dried in a mechanical drier at 60±2°C for 8-10 hours or till no loss of moisture took place. The dried apple pomace was powdered in a grinder and was used in these studies. It was sieved through 48 mesh metallic sieves.

Apple pomace bread : Bread with apple pomace powder was made using six treatments (Experiment 1) by replacing wheat flour (Maida) with apple pomace powder. A general recipe followed in bread making contained flour (100 g), compressed yeast (3 g), sugar (2.5 g), shortening (ghee) (1.0 g), salt (1.0 g), $KBrO_3$ (10 ppm) and water (optimum).

Besides this experiment with apple pomace at 10 to 50%, two other experiments were also conducted. The c hemicals used in the studies were of analytical grade. Details of the treatments used in two other experiments (2 & 3) are given below :

Experiment I

Treatment	Ingredients (wheat flour replaced by pomace)	Approximate pectin* content added (g/100g)
T_1	Control (100% wheat flour)	1.43
T_2	10% pomace	2.86
T_3	20% pomace	4.29
T_4	30% pomace	5.72
T_5	40% pomace	5.72
T_6	50% pomace	7.15

* Based on the composition of apple pomace.

Leavening activity : The leavening activity of yeast in different treatments was determined by the modified cylinder method as described[12]. A known volume (60 CC) of the dough of all the treatments was taken in separate 250 ml measuring cylinders. The cylinders were smeared with a thin layer of groundnut oil inside to aid deposition of the dough at the bottom of the cylinders. After reading the initial volume of the dough in the cylinders, these were incubated at 37°C and subsequent volumes were recorded at regular intervals of 30 min. each.

Analyses : Loaf volume of bread was measured after cooling of the bread loaves using rape seed displacement method[13] and expressed as cubic centimeter (cc). The colour of the bread was observed visually while the texture was felt with finger feel.

Experiment II

Treatment	Ingredients
T_1	Pectin (10%)
T_2	Cellulose (10%)
T_3	Salt (KCl 2000 ppm+$MgCl_2$ 20 ppm+ $MnCl_2$ 0.05 ppm + $ZnCl_2$ 0.05 ppm + $FeSO_4$ 0.05 ppm)
T_4	Pectin + Cellulose + Salts (10%)
T_5	Pomace (10%)
T_6	Control (Wheat flour)

Experiment III

Treatment	Ingredients (Other than basic)
T_1	Pomace 10% + 0.1% yeast extract
T_2	Pomace 10% + 0.1% DAHP
T_3	Pomace 10% + 0.1% malt extract
T_4	Pomace 10% + 0.1% peptone
T_5	Pomace 10% (control)

Physical characteristics of apple pomace bread : Various physical characteristics of bread using different blends of apple pomace powder and wheat flour are presented in Table 1. It is revealed that all the treatments resulted in a decreased loaf volume and increased loaf weight, and water absorption with increased proportion of apple pomace compared to the control (T_1 = 100% flour). Even 10% increase in apple pomace addition resulted in a considerable decrease in loaf volume, increase in loaf weight and water absorption capacity. It has also been found earlier that an increase in water absorption with increasing concentration of apple fibre in gluten-fibre mixtures took place[14]. Further, there might be interaction between apple pomace constituents and gluten resulting in development of gluten with more resistance to mechanical damage, as observed earlier by Chen *et al.*[14]. Similar to our findings, Pomeranz *et al.*,[9] reported that at 5% fibre, the loaf volume decreased to an extent expected from the dilution of the functional gluten proteins. An increase in the concentration of apple fibre, decreased the loaf volume[11]. The similarity of behaviour of inclusion of apple fibres or apple pomace in the bread making can be traced to the composition of both of these sources. The apple fibres contain 31% cellulose, 15% lignin, 12% water-insoluble hemicellulose and 9% water-insoluble pectin[11]. The apple pomace also contains sugars, starch, pectin, crude, fibres etc. as given in Table 2.

A perusal of data presented in Table 1 and of Plates 1 and 2 revealed that the colour of the crust from various treatments was observed to be light brown to dark brown while that of crumb was white for control and creamy to dark brown for other treatments. A comparison of apple promace bread with the control showed that addition of pomace resulted in the production of bread with hard texture which is not desirable. Since apple pomace contained higher amount of pectin (14.32%) it could have resulted in the production of hard texture of bread. The inclusion of pomace may have also made the bread coarse compared to the control. According to Chen *et al.*[11], the main problem of apple fibre bread baking was the weak or 'crippled' dough with reduced ability to retain gas during

Table 1 – Physical characteristics of bread from apple pomace.

Treatment	Loaf volume* (cc)	Loaf weight* (g)	Water absorption* (ml)	Crust characteristics		Crumb characteristics		
				Colour	Spreading	Colour	Texture	Grains
T_1 – Control	465	126	61	Light brown	No	White	Soft	Fine
T_2 + 10% pomace	335 (27.95)	131 (3.96)	67 (9.83)	Brown	Yes, less	Creamy	Semi-hard	Slightly coarse
T_3 + 20% pomace	275 (40.86)	137 (8.73)	74 (21.31)	Brown	Yes	Dark creamy	Hard	Slightly coarse
T_4 + 30% pomace	250 (46.23)	139 (10.31)	79 (29.50)	Brown	Yes, less	Dark brown	Hard	Coarse
T_5 + 40% pomace	240 (48.38)	150 (19.04)	82 (34.42)	Dark brown	Yes, less	Dark brown	Hard	Coarse
T_6 + 50% pomace	230 (50.53)	157 (24.60)	101 (65.67)	Dark brown	Yes, very much	Dark brown	Hard	Coarse
CD P≥0.05%	15.32	6.2	7.51	–	–	–	–	–

In the parentheses the percentage decrease or increase over the control is given.
* Means of three replications.

the baking process. Further, investigations were carried out to understand why appropriate loaf volume and other desirable characteristics of bread could not be achieved.

Effect of flour-pomace blending on leavening activity : In Fig. 1, the volume of different blends of dough is plotted against time to see the effect of addition of apple pomace powder to wheat flour on leavening activity. A comparison of the rates of fermentation (change in dough volume with time) for different blends with the control showed a general decrease in the volume. It could possibly be due to the dilution of gluten which is basically responsible for the binding character within the dough and its retention while baking. It has been reported that gluten development depends upon different factors like mechanical action (Kneading), amount of proteolytic enzymes, oxidation of the flour,

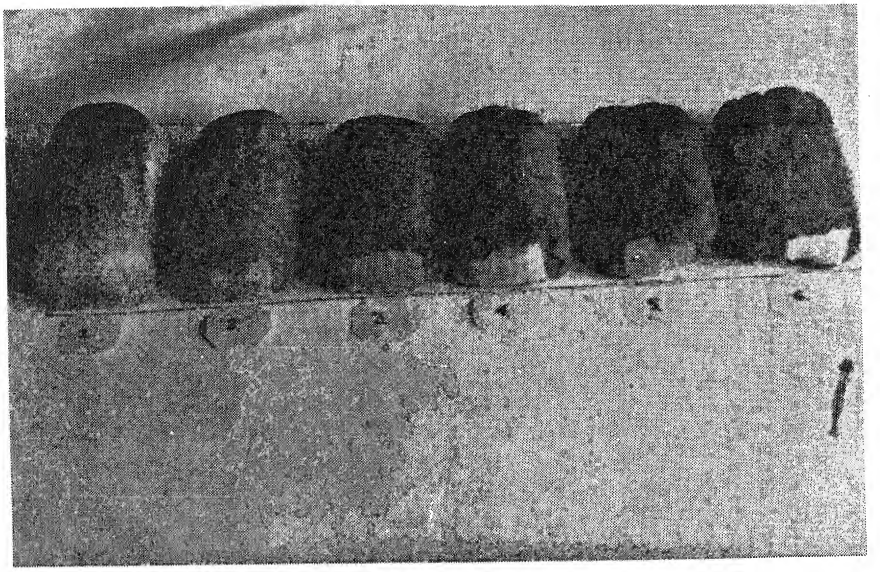


Plate 1 – Apple Pomace Bread of different treatments.

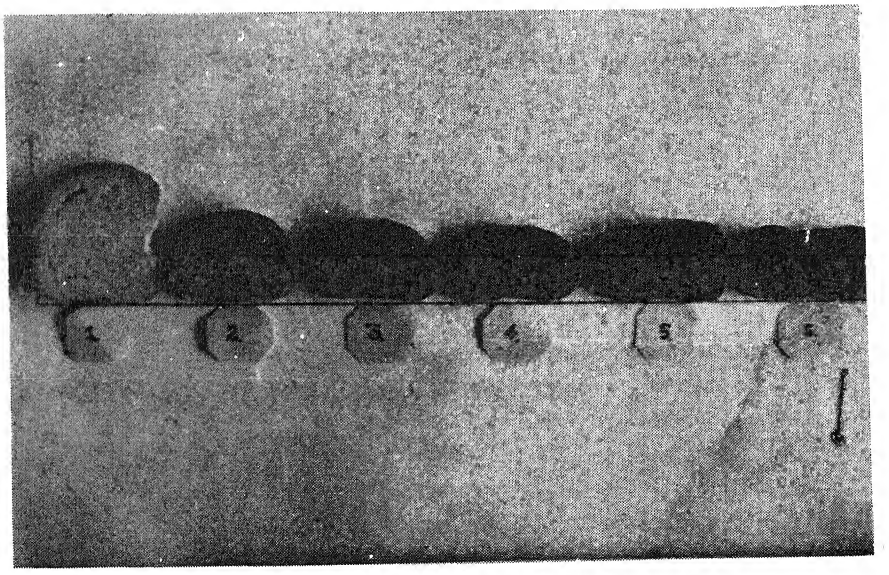
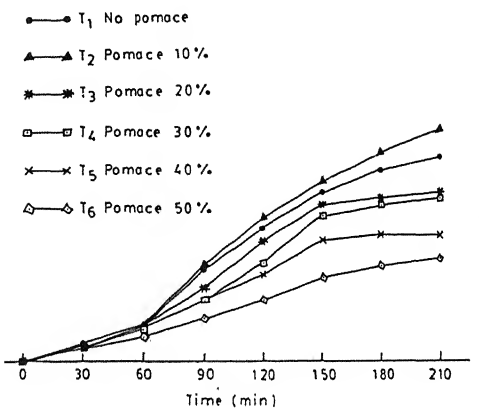


Plate 2 – Apple Pomace Bread (Crust and Crumb) of different treatments.



– Effect of flour & pomace blending on Leavening Activity in dough.

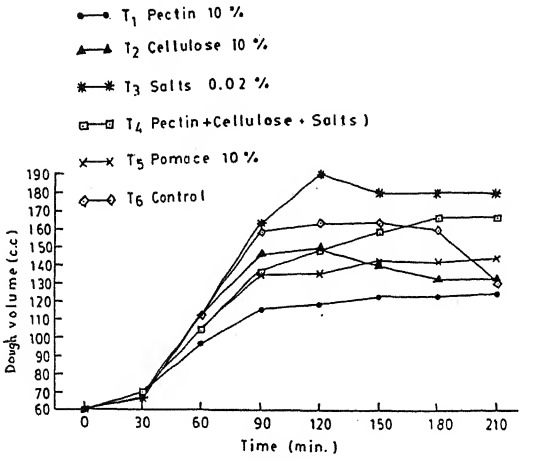


Fig. 2 – Effect of Additives on Leavening Activity in dough.

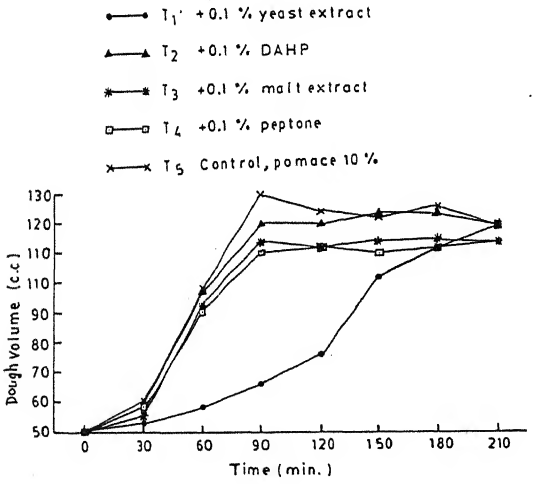


Fig. 3 – Effect of Additives on Leavening Activity in dough.

Table 2 – Some physio-chemical characteristics of apple pomace powder.

Constituents (%)	Mea..1 (± SE) t 0:05, n–1
Total soluble sugars	22.50 ± 4.17
Pectin (as calcium pectate)	14.32 ± 2.64
Starch	15.39 ± 2.79
Crude fibre	19.72 ± 3.91

addition of milk, inorganic ions (Ca^{++}, PO_4^{3}), sucrose and fat[15].

The effect of addition of apple fibre and cellulose on the physical properties of wheat flour indicated a slowing down of the rate of hydration and development of gluten indicating a possible interaction of fibre and gluten leading to poor baking properties of apple fibre bread[11]. The incomplete hydration of gluten could also have deleterious effect on the dough development[16]. The main problem in apple fibre bread making seems to be the production of weak or crippled dough with a reduced ability to retain gas during the baking process as observed in cookies preparation earlier[11].

Effect of different additives on leavening activity : The leavening activity of yeast in different flour-pomace blends as influenced by different additives (Fig. 2) gives the experimental evidence and the effect of flour pomace blending that all the additives resulted in an increase in the leavening activity of doughs over the control (T_6) except pectin (T_1) at the end of 210 min. Salt mixture (T_3) resulted in maximum leavening followed by pectin + cellulose + salts mixture (T_4). However, upto approximately 160 minutes control (T_6) followed T_1 but then it declined sharply. Based upon this data, it could be concluded that pectin tends to decrease the leavening activity in dough. However, ability of a dough to retain gas reportedly depends directly on the amount and quality of the gluten developed. Addition of different sources of nutrition for yeast alongwith 10% pomace in the basic ingredients of dough was evaluated for their effect on the leavening activity of bread (Fig. 3). It can be seen that pomace (T_5) alone allowed the maximum leavening activity followed by pomace + DAHP mixture (T_2). Pomace + yeast extract (T_1) had the minimum leavening activity upto 180 min. However, (T_3 and T_4) at the end of 210 minutes recorded the lowest leavening activity while all other treatments including the control were having higher dough volume. In general, leavening activity with or without additives remained almost the same.

In an overview of the results on the use of apple pomace powder in bakery products, one of the experiments gave the evidence that fibres affected the leavening activity to a

greater extent. It could be due to the dilution of gluten content and reduced retention of CO_2 during baking that no leavening could be achieved as observed earlier. It was also concluded from the experiments that it was pectin which might be responsible for reduction in CO_2 retention in the dough. Only partial increase in the leavening activity of the dough could be obtained indicating that factors other than leavening activity of yeast might be controlled for incorporation of the apple pomace powder in the bread making, needing more detailed studies.

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Chemical constituents of essential oils from callus and *in vitro* derived field grown plants of *Artemisia pallens* through GLC

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Abstract The callus and *in vitro* derived field grown plants of *Artemisia pallens* showed variation in chemical constituents. These predominantly contained terpenoides and alcohols. Pentanol, hexanol, E/Z-hexenol, 2-furaldehyde/myrcene, benzylalcohol, and alpha-ionone were present only in the callus, while caprylic acid and geranyl acetone were noted as additional constituents in the plant extract. Maximum number of multiple shoots regenerated on MS+Kn (1 mg/l) while MS+2,4-D (1mg/l) + BA (1mg/l) proved best for callus induction.

(**Keywords :** *Artemisia pallens*/linalool/callus/gas liquid chromatography).

Davana oil, a natural essential oil is derived from the aromatic herbaceous annual *Artemisia pallens* Wall of the *Asteraceae*. The oil is much valued in perfumery, cosmetics and as flavouring agent in food industry throughout the world. In India, the plant is under commerical cultivation for its oil. It has, however, not attained wide popularity because of high price. Nevertheless, USA, Europe and Japan have been evincing interest in the essential oil from *A. pallens* chiefly for its use in flavouring cakes, tobacco and also some expensive beverages[1,2].

Linalool is one of the most important aromatic isolates of davana oil, used widely in the perfume, cosmetic, soap and flavour industry.

The chemical composition of the oil has been investigated by earlier workers[3-6]. The role of minor components imparting delicate and exhaustive aroma of the oil has been summarized[7]. The major component, davanone, is odourless when purified vigorously[8,9]. This characteristic feature led us to perform a detailed investigation of chemical constituents of the oil from both callus and field grown plants.

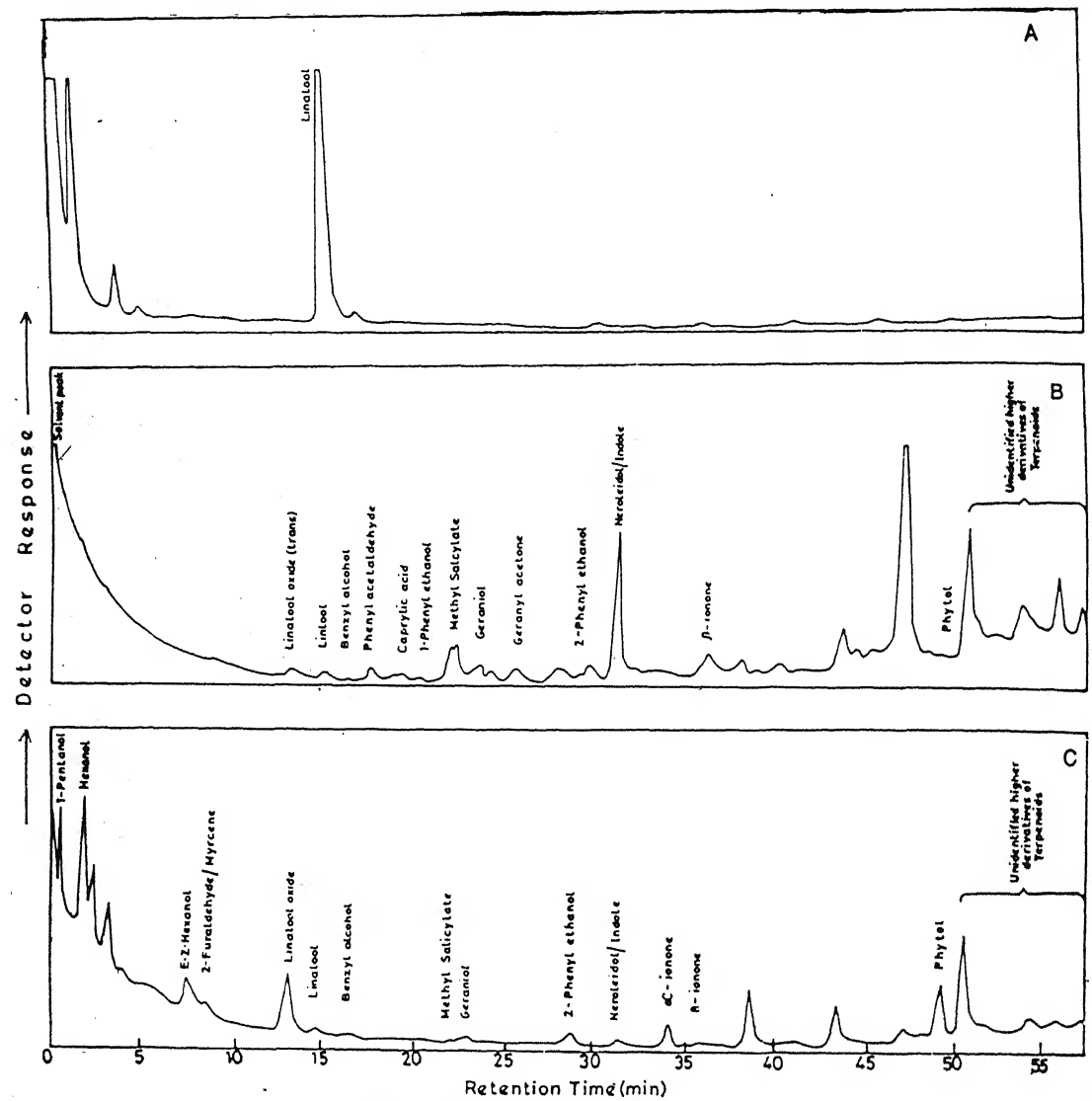
Since rapid loss of viability has been observed in the older seeds[10], fresh seeds were preferred. Seeds of *Artemisia pallens* obtained from Kadiri (A.P. India) flower market were thoroughly washed and surface sterilized with 0.05% mercuric chloride for 5 minutes. They were then washed thoroughly with sterile distilled water and inoculated aseptically on MS basal medium[11]. Aseptic seedlings of 15 days were transferred to MS medium supplemented with different plant growth hormones. The cultures were grown under continuous

Table 1 – Constituents of essential oil of callus cultures and *in vitro* derived field grown plants of *Artemisia pallens* analysed through GLC.

S. No.	Constituents	Nature of compounds	Relative percentage	*in vitro* derived field grown plants	Callus
1.	Pentanol	Alcohols	2.80	–	+
2.	Hexanol	– do –	8.97	–	+
3.	E/Z Hexenol	– do –	7.02	–	+
4.	2-Furaldehyde/ Myrcene	Acyclic monoterpene	2.40	–	+
5.	Linalool oxide	– do –	8.35	+	+
6.	Linalool	– do –	0.76	+	+
7.	Benzyl alcohol	Alcohol	0.31	–	+
8.	Methyl salicylate	Phenolic ester	0.02	+	+
9.	Geraniol	Acyclic monoterpene	0.55	+	+
10.	2-Phenylethanol	Alcohol	3.25	–	+
11.	Nerolidol/Indole	Acyclic sesquiterpene	1.24	+	+
12.	α-Ionone	Monocyclic sesquiterpene	1.24	–	+
13.	β-Ionone	– do –	0.69	+	+
14.	Phytol	Acyclic diterpene	6.16	+	+
15.	Caprylic acid	Aliphatic carboxylic acid	0.04	+	–
16.	Geranyl acetone	Acyclic monoterpene	2.80	+	–

fluorescent light (PAR = 45 μE M^2S^{-1}) at 25 ± 2°C. The photoperiod regime was 16h light and 8h dark diurnal cycles. In all experiments 20 replicates were maintained and each experiment was repeated thrice.

In the present study more number of multiple shoots and more amount of callus were obtained on a range of concentrations of 2,4-D, BA, NAA and kinetin than earlier studies on the same plant. Different con-



(A) Standard Linalool (B) *In vitro* derived field grown plant (C) Callus.

Column	:	Glass column 2mx5mm (OD) containing 3% OV-17 on Gas-Chrom Q(80/100).
Initial temperature	:	100°C
Initial hold time	:	4 min
Rate	:	4° per min
Final temperature	:	240°C
N_2 flow	:	40 ml min^{-1}

Fig. 1 – GLC profiles of essential oils of *Artemisia pallens*.

stituents of the callus and *in vitro* derived field grown plant extracts were investigated.

Chemical analysis : 2g of each 4-week-old callus and *in vitro* derived 8-month-old field-grown plants were collected and homogenised in a waring blender and extracted 3 times with 100 ml of Hexane (B.P. 60-80°C) each time. The organic extracts were pooled and the solvent was evaporated on a rotary flash evaporator. The residue was dissolved in 0.2-0.5 ml $CHCl_3$ and used for TLC and GLC analysis.

TLC was carried out over silica gel 'G' plates using benzene as solvent. The chemical components of oil were visualised by using anisaldehyde reagent and kept in an oven for 5 min at 60°C. GLC analysis was carried out with Shimadzu GC-7A model using glass column 2m × 5 mm (OD) containing 3% OV-17 on Gas-Chrom Q (80/100), initial temperature of 100°C, initial hold time 4 min, rate 4° min^{-1} at a final temperature of 240°C; N_2 flow was 40 ml min^{-1}.

Among the different MS media with varied hormonal combinations tested, the best response was observed on MS medium supplemented with Kn (1 mg/l) in the production of more number of multiple shoots. MS medium supplemented with 2, 4-D (1 mg/l) and BA (1mg/l) was more effective in inducing callus.

Quantitative analysis of the GLC profiles of the essential oils of callus and *in vitro* derived field grown plants revealed the presence of linalool oxide, linalool, phenylacetaldehyde, methylsalicylate, geraniol, 2-phenylethanol, nerolidol, indole, beta-ionone and phytol as common constituents of both callus and *in vitro* derived plant extracts (Table 1). Pentanol, hexanol, E/Z-hexenol, 2-furaldehyde/myrcene, benzylalcohol and alpha-ionone were present only in the callus, while caprylic acid and geranyl acetone were noted as additional constituents in plant extracts (Table 1; Fig. 1). The qualitative differences in the chemical constituents of callus and *in vitro* derived field grown plants of *A. pallens* observed in the present investigation are first of its kind ever reported.

The chemical composition of the oil from *A. pallens* have been investigated by a number of research workers. Cinnamyl cennemate, caryophyllene, cadinene, various phenols and acids were identified[3], but no phenol[8]. A number of sesquiterpene hydrocarbons and oxygenated compounds were also identified[3] but the chemical species were not characterised. A new sesquiterpene ketone which was named 'davanone' was observed[4]. A new sesquiterpene ketone and named as artemone was isolated from Davana plant[12]. Further terpenoids were named as 'davana furans'[6]. Of the 32 peaks resolved by GLC, only three could be identified[13].

In the present investigation, GLC data revealed that the extract contained predominantly terpenoids and alcohols. Among terpenoids, it contains many mono, sesqui and diterpenes. This variation may be attributed to several factors such as plant variety, cultivation conditions and geographic localization.

Apart from the identification of chemical constituents, we have also determined the percentage composition of the components (Table 1). Though linalool occurs at a relatively lower percentage, it contributes to the characteristics odour of davana oil.

The authors are grateful to Dr. G.A. Ravi Shankar, Head and Dr. G.S. Suvarnalatha, RA, Division of Plant Biotechnology, CFTRI, Mysore, for their helpful suggestions and guidance and grateful to CSIR for providing financial assistance.

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pH-dependent phototransformation of 5,5-diphenylhydantoin

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Abstract 5,5-Diphenylhydantoin when photolysed by UV light at different pH, gave urea (II), benzophenone (III) and carbonmonooxide at acidic pH and 1,5-diphenylhydantoin (IV) at alkaline pH. The structures of these products have been established by spectral and elemental analysis.

(**Keywords** : UV/phototransformation/5,5-diphenylhydantoin)

Photochemistry of organic compounds has been a vast field of research since long. A thorough survey of the literature shows that very little work has been done on the photochemistry of 5,5-diphenylhydantoin[1]. Therefore, here we report the photolysis of 5,5-diphenylhydantoin at different pH.

Preparation of 5,5-diphenylhydantoin : It was prepared by the reaction of benzil and urea[2].

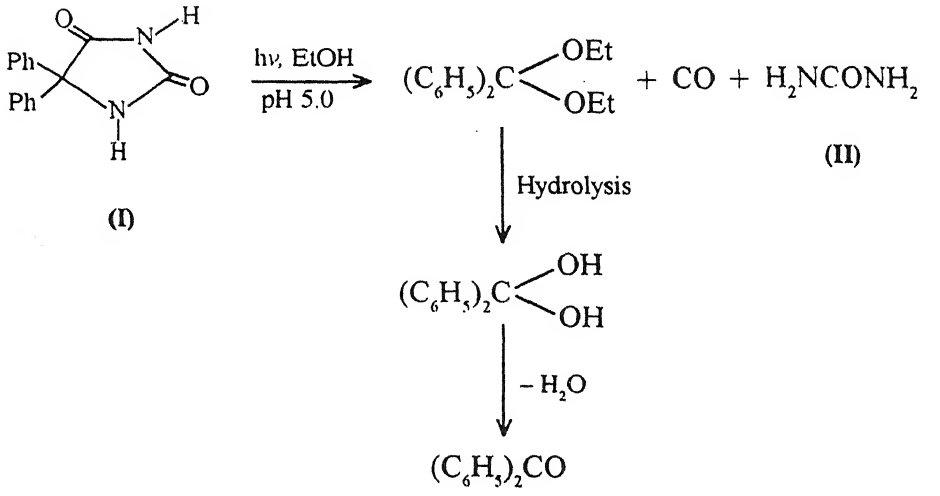
Photochemical reaction of 5,5-diphenylhydantoin in acidic medium : 5,5-Diphenylhydantoin (1.0g) wad dissolved in 100 ml dry ethanol. To this solution dilute HCl was added. The pH was recorded to be 5.0. Benzophenone was added as sensitizer and then the solution was irradiated by 125W mercury vapour lamp. The progress of the reaction was monitored by TLC. The reaction completed in 30 h. Then the irradiation was stopped. The reaction mixture was neutralized and concentrated by distillation on a water bath under reduced pressure. The products were separated by fractional crystallization and were recrystallized from alcohol.

Photochemical reaction of 5,5-diphenylhydantoin in alkaline medium : The reaction ws carried out in the same manner as in the acidic medium. The solution was made alkaline by adding dil. NaOH and pH was recorded to be 9.0. The reaction completed in 22 h. The reaction mixture was neutralized and concentrated on a waterbath under reduced pressure and then was left overnight when a colourless solid separated out. It was filtered and recrystallized from ethanol to give colourless needles. M.p. 202-204°C (Lit. M.p. 204°C).

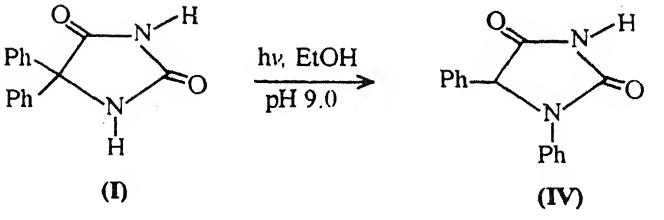
Found–C, 72.12%; H, 4.84%; N, 10.0%, $C_{15}H_{12}N_2O_2$, requires–C, 72.00%; H, 4.80%; N, 9.80%.

5,5-diphenylhydantoin (1) when irradiated by UV light at pH 5.0, gave urea (II), benzophenone (III) and carbonmonooxide (Scheme I). The identity of (II) and (III) has been established by mixed melting point and Co-TLC with the authentic samples.

Irradiation of I at pH 9.0 gave 1,-diphenylhydantoin (IV) (Scheme 2) by rear-



Scheme 1



Scheme 2

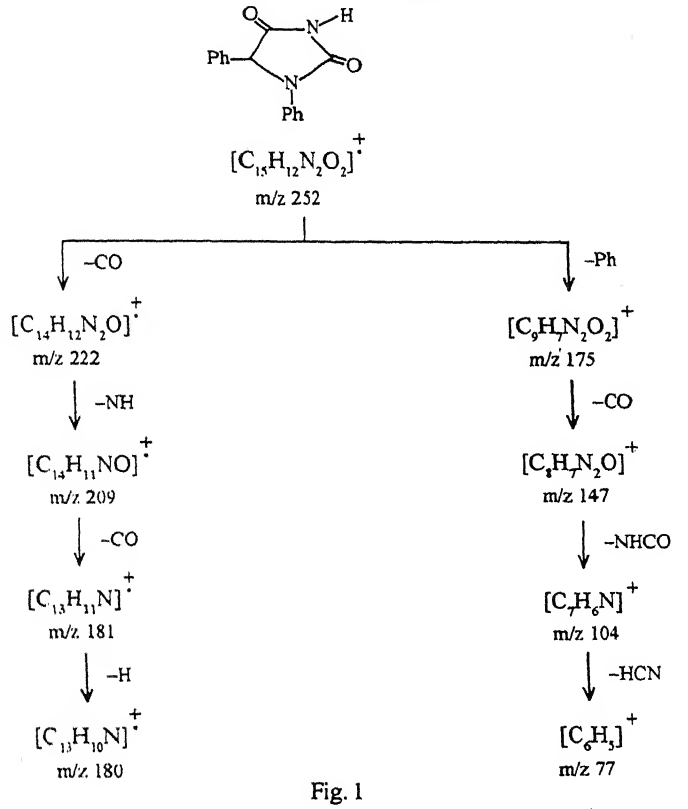


Fig. 1

rangement. Its IR spectrum (in KBr) shows important absorption bands at 3232 cm^{-1} (N–H stretching); 1708 cm^{-1} (C=O stretching Lactam ring); 1446–1602 cm^{-1} (C=C stretching benzene ring) etc. The ^1H NMR spectrum (in $CDCl_3$) gave signals at δ7.3-7.4 at δ 118–120 (aromatic carbon atoms); δ 197.3 (carbonyl carbons) and δ 68 (carbon in five membered ring). The mass spectrum gave molecular ion peak at *m/z* 252. Other peaks were observed at *m/z* 223, 180 (base peak), 147, 104 etc. (Fragmentation pattern in Fig. 1).

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QSAR study on a new class of potent H_1 antagonists

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Abstract Molecular redundancy index (MRI) is used for modelling antihistaminic activity of a series of potent H_1 antagonists. Regression analysis indicated that a good correlation exists between the activity and MRI. Result have shown that in proposing appropriate QSAR model introduction of dummy parameters was necessary. Finally, the first order valence connectivity index ($^1\chi^v$) in combination with MRI gave excellent QSAR model for modelling the activity.

(**Keywords :** QSAR/H_1 antagonists/molecular redundancy index/antihistaminic activity/first order valence connectivity index)

Quantitative structure activity relationships (QSAR) have been shown to be powerful research tool and are being used in many fields[1-3]. There are two basic kinds of molecular descriptors used in QSAR. One of them involves parameters that bear relation to free energy and usually represent some of the important physico-chemical properties of the molecules[4] (Hansch approach). Another category of molecular descriptor is the topological index which is produced directly from molecular structure[5] (topological approach).

In recent years, topological indices have gained attention in explaining biological activities and physical and chemical properties of organic compounds[6-10]. However, there are only a few topological indices which can be used to describe QSAR relationhips[1-5]. So also, there are some topological indices on which very little or no work is done. Attempts are still lacking in developing thier potential to model appropriate statistical QSAR model[19]. One such index is the molecular redundancy index (MRI)[11]. Since its introduction, very little work is done on its use in QSAR studies.

In view of the above we have used MRI for modelling antihistaminic acgivity for a new class of potent H_1-antagonists presented in Fig. 1 and Table 1.

Since Randic[6] connectivity is widely used in QSAR, first order connectively index ($^1\chi^v$)

is used in combination with MRI with a hope of obtaining excellent model. We observed that in addition to MRI and $^1\chi^v$ introduction of indicator parameters gave excellent results which are discussed below.

Recently Saxena *et al.*[12] synthesized and evaluated biological activity of some potent H_1 antagonists as shown in Fig. 1 (Table 1) and Eqn. 1 :

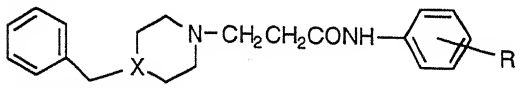


Fig. 1. 1-[{(Arylamino)carbonyl}ethyl]-4-benzylpiperazines and -piperidines used in the present study.

$$\log 1/I_{50} = 0.363\ \pi - 0.126 \qquad (1)$$
$$n=10,\ R=0.813,\ Se=0.131,\ F=15.63$$

where π is hydrophobicity of the side chain.

The model suggested by Saxena *et al.*[12] is based on some property associated with the substituent and not with the structure as a whole. Saxens's model[12], therefore, do not give 1:1 correlation between structure and activity. Hence, this was the objective of the present study in that we have used topological indices (MRI and $^1\chi^v$) for modelling the antihistaminic activity.

Molecular Modelling

Biological profile : Antihitaminic activity (H_1) for the set of compounds used (Table 1) was measured by Saxena *et al.*[12] on the isolated terminal part of guinea pig ileum (5-cm long) suspended in an organ bath containing aerated Tyrode solution (20mL) at 35°C and spasm of the ileum was induced with $3x10^{-8}$ g/mL of histamines. The percentage of inhibition was plotted by them aginst different concentrations of the compound and the concentration causing 50% inhibition (I_{50}) was calculated. These values of I_{50} are given in Table 1 and are adopted in the present study.

Molecular Redundancy Index (MRI) : A message or information in the form of electron probability fields distributed around in space in a frame work of atomic radii has led to introduction of molecular descriptor referred to as molecular redundancy index (MRI), derived from information theory and molecular graph theory[13,14]. MRI leads to quantification of the information content and encodes the silent steric properties of the molecules in cases where biological activity is non-specific. It ranks them correctly according to non-specific biological potency and thus, provides mechanistic interpretation of drug at molecular level based on probability consideration.

The Molecular Connectivity Indices : The connectivity index $\chi = \chi(G)$ of graph G is defined by Randic[6] as under:

$$\chi = \chi(G) - \sum_{ij} [d_i\, d_j]^{-0.5} \qquad (2)$$

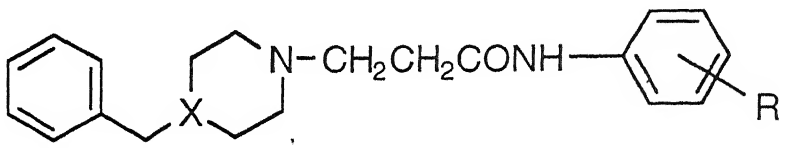
where d_i is the valence of a vertex i, equal to the number of bonds connected to the atom i, in G, representing the graph of a compound. Meaning of d_j is analogous.

In the case of hetero systems the connectivity is given in terms of valence delta values δ_i^v and δ_j^v of atoms i and j and is denoted by χ^v. This version of the connectivity index is called the valence connectivity index and defined as[10] under :

$$\chi^v = \chi^v\ (G)_{ij} = \sum [\delta_i^v\ \delta_j^v]^{-0.5} \qquad (3)$$

where the sum is taken over all bonds i-j of the molecule.

Table 1 – H_1-antagonists, 1-[[(Arylamino) carbonyl]ethyl]-4-benzylpiperazines and -piperidines, used in the present study. MRI and $^1\chi^v$ alongwith their antihistaminic activity[a].



S.N.	*R*	*X*	I_{50}	$^1\chi^v$	MRI	Ip_1	Ip_2
1	2-C_2H_5	N	0.33	9.6038	0.3265	1	0
2	2-Cl	N	0.36	9.1459	0.3528	1	1
3	2-F	N	0.31	8.4922	0.3528	1	1
4	H	N	0.71	8.6273	0.3869	1	0
5	2-NO_2	N	0.75	9.0814	0.3425	1	0
6	2-C_2H_5	CH	0.17	9.8798	0.2762	0	0
7	2-Cl	CH	0.20	9.4219	0.2943	0	1
8	2-F	CH	0.28	8.7082	0.2943	0	1
9	H	CH	0.49	8.9033	0.3276	0	0
10	2-OCH_3	CH	0.34	9.4329	0.2826	0	0

a MRi = Molecular redundnacy, $^1\chi^v$ = First-order valence connectivity index,
Ip_1 = Indicator parameter with the value of unity when the substituent at *X* is nitrogen (N) otherwise it is zero, Ip_2 = Indicator parameter with the value of unity when the substituent at *R* is halogen otherwise it is zero, I_{50} (μg/ml) = Antihistaminic activity of the compounds used and mentioned in Table 1.

Indicator Parameters: Two structurally related dummy parameters (indicator parameters) Ip_1 and Ip_2 were also used. The Ip_1 has been assigned a value of unity when the substituent at X is nitrogen (N) otherwise it is zero. Similarly Ip_2 is unity when the substituent at R is halogen otherwise it is zero.

Regressiion Analysis : We have used the maximum R^2 improvement method to identify prediction models[15,16]. In all regression models developed we have examined a variety of statistics associated with residues, i.e. the Wilks-Shapiro test for normality and Cooks

Table 2 – Comparison of estimated and observed antihistaminic activity of the compunds used in the present study.

Compd.	I_{50}	I_{50} Estimated from					
		Regression (6)		Regression (7)		Regression (8)	
No.	Obs.	Est.	Residue	Est.	Residue	Est.	Residue
1	0.33	0.48	−0.15	0.42	−0.09	0.44	−0.11
2	0.36	0.40	−0.04	0.33	0.03	0.30	0.06
3	0.31	0.40	−0.09	0.44	−0.13	0.47	−0.16
4	0.71	0.71	0.00	0.72	−0.01	0.68	0.03
5	0.75	0.54	0.21	0.54	0.21	0.57	0.18
6	0.17	0.28	−0.11	0.25	−0.08	0.25	−0.08
7	0.20	0.18	0.02	0.14	0.06	0.11	0.09
8	0.28	0.18	0.10	0.24	0.04	0.28	0.00
9	0.49	0.48	0.01	0.53	−0.04	0.49	0.00
10	0.34	0.31	0.03	0.33	0.01	0.36	−0.02

Residue = Difference between observed and estimated I_{50} activity.

D-statistics[16] for outliers, to obtain the most reliable results.

A perusal of Table 1 shows that the compunds under present study can be classified under two classes: (i) when X=N and (ii) when X=CH. The compunds belonging to the first category (i.e. when X=N) are comparatively more active. Also that, in both the categories when R=H, the activity is highest.

Taking all the ten compounds together, the following sequence of the activity was observed:

$$5 > 4 > 9 > 2 > 10 > 1 > 3 > 8 > 7 > 6 \quad (4)$$

In terms of substituentR, this sequence can be written as below:

$$H > 2NO_2 > H > 2\text{-}Cl > 2\text{-}OCH_3 > 2\text{-}C_2H_5 > 2\text{-}F >> 2\text{-}F > 2\text{-}Cl > 2\text{-}C_2H_5 \quad (5)$$

The above sequence doesn't indicate any relationship between the nature and position of the substituents R on antihistaminic activity.

In view of the above, we have attempted simple and multi- parametric topological modelling of the activity using MRI, $^1\chi^v$, Ip_1 and Ip_2. The results are discussed below.

During the process of successive regression analysis we observed that the quality of

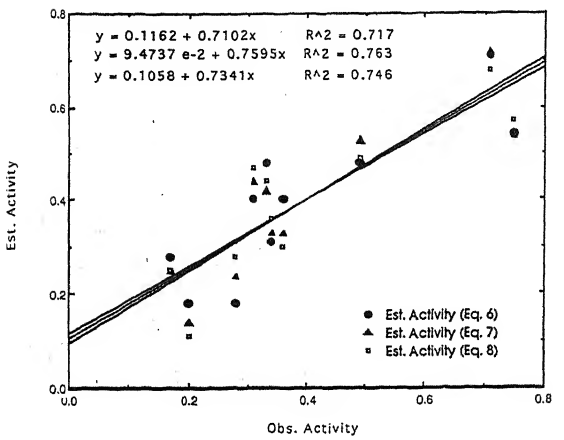


Fig. 2 – The correlation of estimated (ref. Eq. 6 to 8, Table 2) and observed antihistaminic activities (I_{50}) of H_1 antagonists used in the present study.

mono-parametric correlation involving MRI (Eqn. 6) is improved and finally, a bi-parametric correlation (Eqn. 7) involving MRI and Ip_2 gave the best results. The involvement of MRI indicates that the antihistaminic activity is controlled by the symmetry of the molecules acting as drugs

$$\text{Activity } (I_{50}) = 3.8625\ \text{MRI} - 0.8561 \quad (6)$$

$$\text{Se} = 0.1486,\ R = 0.7055,\ F = 7.928,\ Q = 4.748$$

$$\text{Activity } (I_{50}) = 3.8586\ \text{MRI} - 0.1769\ Ip_2 - 7.836 \quad (7)$$

$$\text{Se} = 0.1265,\ R = 0.8433,\ F = 8.615,\ Q = 6.998$$

The quantity of bi-parametric correlation is further improved in tri-parametric correlations and tri-parametric correlation (Eqn. 8) involving MRI, $^1\chi^v$ and Ip_2 gave the best results.

$$\text{Activity } (I_{50}) = 2.6428\ \text{MRI} - 0.1477\ {}^1\chi^v - 0.2255\ Ip_2 + 0.9723 \quad (8)$$

$$\text{Se} = 0.1172,\ R = 0.8752,\ F = 6.544,\ Q = 7.468$$

The statistical data presented indicate that correlation involving all the four molecular descriptors (MRI, $^1\chi^v$ and Ip_1 and Ip_2) has the same value of R as that of Eqn. 8. The coefficient of $^1\chi^v$ term in Eqn. 8 indicates that the electronic effects are secondary in exhibiting activity and that the activity is governed by symmetry of the molecule as a whole.

In all the proposed correlations generally the coefficient of MRI term more or less remains the same indicating thereby the changes in the activity due to substructural variation in the side chain phenyl ring is similar in all the cases. This further indicates that the side chain phenyl ring in all the compounds studied occupy the same receptor site.

In order to confirm our findings we have estimated quality factor (Q)[13] for all the aforementioned models. This quality factor (Q) is the ratio of correlation coefficient to the standard error of estimation (Q=R/Se). Q values obtained for the aforementioned multivariate correlations are found as: 4.7476, 6.9983 and 7.4675 for models 6, 7 and 8 respectively. These Q-values indicate that the correlation Eqn. 8 is the best QSAR model for modelling and estimating antihistaminic activity. We have also estimated antihistaminic activity using each of the models 6, 7 and 8 and compared them with the observed activity. The observed predictive correlation coefficient, $R^2 = 0.763$, confirms these findings.

The comparison of our results with those of Saxena *et al.*[12] indicates that the topological descriptors (MRI and $^1\chi^v$) used by us are better molecular descriptors compared to π, σ and MR used by Saxena *et al.*[12]

Furthermore, in Saxena *et al.*[12] approach statistically significant results (R values = 0.908 and 0.903) were only obtained when the compounds were splitted into two groups of five compounds each. When all the ten compunds were used by them the quality was reduced (R=0.813). In our model on the other hand there was no need of such splitting. In the non-splitted condition our R value was much higher (R=0.875) than that obtained by Saxena *et al.*[12]

From the present study we conclude that antihistaminic activity of the series of H_1 antagonists can be modelled using molecular redundancy index (MRI). In monoparametric correlations activity does not correlate with any of the molecular descriptors (correlating parameters) used i.e. $^1\chi^v$, Ip_1 or Ip_2.

The correlation potential of MRI in monoparameteric correlation is increased when it is coupled with the valence connectivity index ($^1\chi^v$) as well as the dummy parameters Ip_1 and Ip_2.

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Histological evidence for toxic damage induced by selenium salts

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Abstract Swiss albino mice were tested with two salts of selenium – sodium selenite and sodium selenate following parental administration. Four different fractions of LD_{50} of each salt corresponding to 7, 14, 21 and 28 mg/kg bw were used and observations were made after 24 hours exposure. Pathological changes to different target organs especially liver, kidney and stomach were studied. The changes in the target organs were remarkable in dose dependent manner.

(**Keywords:** selenium/liver/kidney/stomach/toxicity)

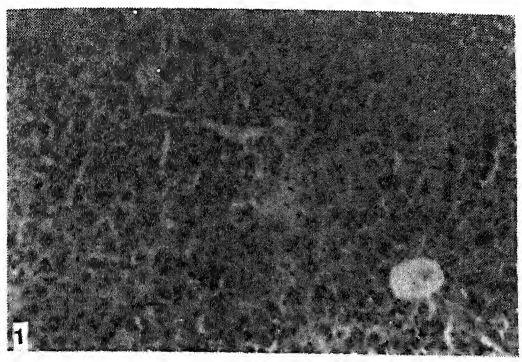
In human as well as animals, the selenium is an essential trace element[1]. It is known to be a cofactor in the enzyme glutathione peroxidase[2,3]. During the last decade, selenium has received much attention as an antidote for different heavy metal poisoning[4] and as an anticancer agent[5]. In view of its preventive effects many individuals are supplementing their diets with amounts that are greater than the recommended daily requirements. In doses higher than the tracer doses, selenium compounds cause various toxic effects[6]. Three clinical types of selenium intoxications were reported: acute, subacute and chronic selenosis[7,8]. Acute poisoning occurs when high selenium containing plants are consumed in large quantities within a short period. Accidental acute poisoning occurs as a consequence of errors in formulation of a slenium diet[8].

Hence the toxicity of selenium salts was planned to study in the animal system. In this study, the evidence for the acute toxic damage on various organs produced in mice by selenium salts (both Na_2SeO_3 and Na_2SeO_4) at different concentrations following oral ingestation are presented.

Animals : Male Swiss albino mice (*Mus musculus*, L; 2n=40), 6-8 weeks old weighing 25-30g were used as test system. Six mice were housed in stainless steel wire polycarbonated cages with husk bedding. They were maintained in air conditioned rooms under standard laboratory conditions (temperature 18±2°C, humidity 50±15% and photoperiod of 12h L/D cycle). Commercial pellet diet (Hindustan Lever, India) and distilled water were given *ad libitum*.

Toxicants tested : Sodium selenite (Na_2SeO_3, mol. wt. 172.94, BDH England, CAS No. [10102-18-81]) and sodium selenate (Na_2SeO_4, mol. wt. 188.94, Koch Light, U.K., CAS No. [13410-01-01]) were used as toxicants.

Treatment : Sixty mice were treated by oral administration of salts as per schedule



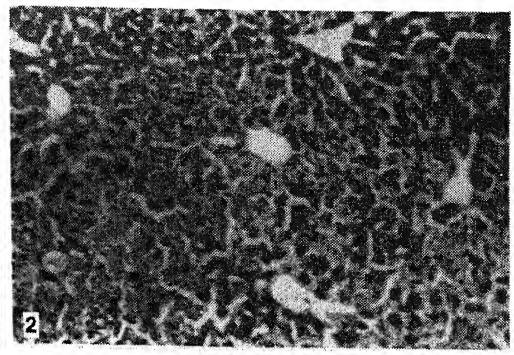
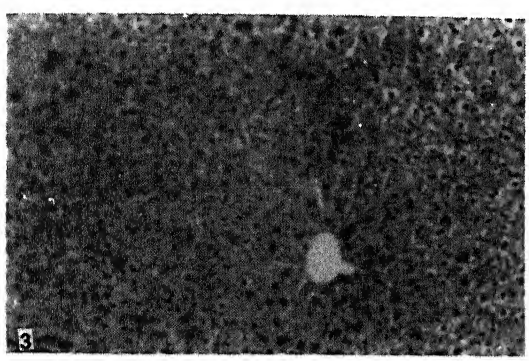


Fig. 1 – Normal structure displaying cords of liver cells radially disposed around the central vein and oriented on both sides of sinusoids with no abnormal variation in liver cell size and nuclei. (ca × 100).

Fig. 2 – Liver cells large and swollen having clear cytoplasm with altered plate pattern upon treatment with 7mg/kg bw sodium selenite orally in mice (ca × 100).



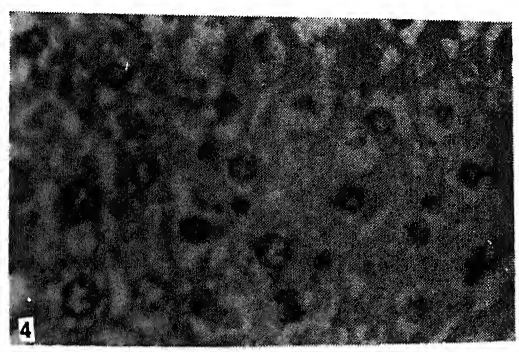
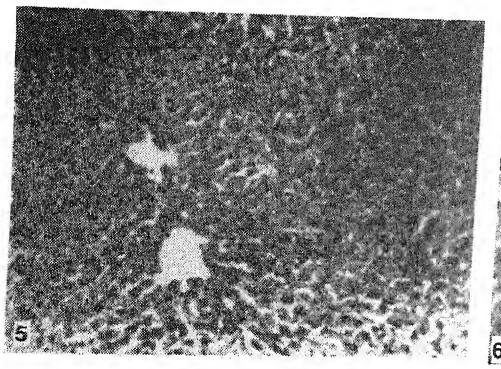


Fig. 3 – Liver cell changes are throughout the liver lobule with severe changes near the centrilobular vein with mice treated with 14mg/kg bw of sodium selenite orally. (ca × 100).

Fig. 4 – Liver having swollen hepatocytes with pyknotic nuclei and distinct karyorrhectic changes in mice orally treated with 21 mg/kg bw of sodium selenite (ca × 450).



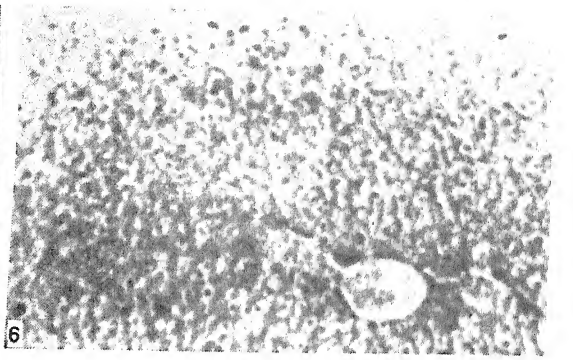
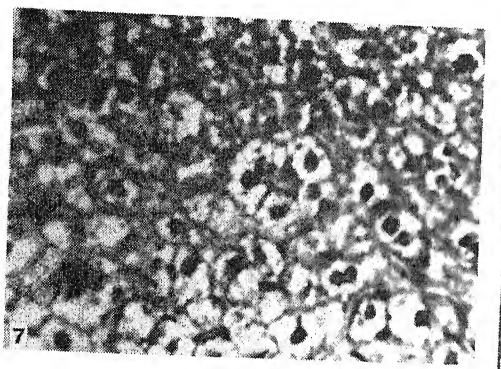


Fig. 5 – Widespread degeneration of the hepatocytes in mice orally treated with 21 mg/kg bw of sodium selenite. (ca × 100).

Fig. 6 – Liver sections showing diffuse liver cell injury with lobular disarray (ca × 100). Mice treated orally with 28 mg/kg bw sodium selenate.



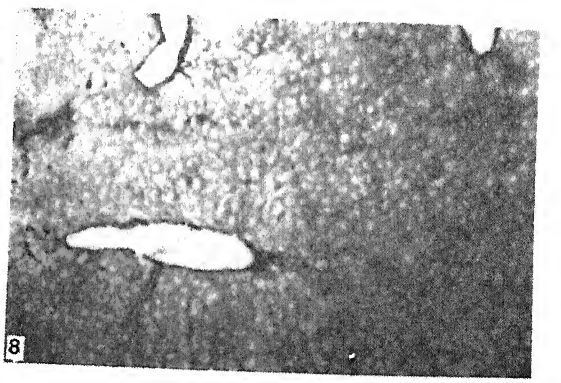


Fig. 7 – Liver depicting necrotic changes having pyknotic, karyorrhectic and karyolytic nuclei. Mice orally treated with 28 mg/kg bw of sodium selenate (ca × 450).

Fig. 8 – Photomicrograph of selenium treated liver tissue after reticulin staining having closing up of central vein and fine scarring around it (ca × 60).

(See, Table 1). Salts were dissolved in distilled water and single doses were slowly administered by oral gavage to six male mice per dose with a feeding needle fitted to a tuberculin syringe. The posology given was 7, 14, 21 and 28 mg/kg bw for both the salts corresponding to 1/8, 1/4, 1/3 and 1/2 of LD_{50} for sodium selenite and 1/10, 1/5, 3/10 and 2/5 for sodium selenate respectively. Two sets of control, a positive and a negative control group were also maintained respectively with mitomycin C and distilled water.

Preparation of histological slides : All the animals were observed for 24 hours and were sacrificed by cervical dislocation and necropsy was performed. Liver, kidney and stomach were removed, fixed in 10% formal saline, processed and embedded in paraffin. Tissue blocks were cut at 4μm and sections were stained with hematoxylin and eosin. Liver sections were stained in silver solution for reticulin fibres also. Observations were carried out with a Carl Zeiss binocular microscope.

No observable changes were seen in liver, kidney and stomach upon gross examining. The effects of the two salts-sodium selenite and sodium selenate, observed in blind manner were similar at comparable doses upon microscopic observation. The general effects induced by sodium selenite and sodium selenate are described below :

Liver : Dose dependent cytotoxic effects were observed in the treated liver as compared to normal hepatocytes (Fig. 1). The treated sets showed great variation in size and staining qualities of liver cells leading to obliteration of the normal radial arrangement (lobular disarray). The liver cells were large (swollen) with empty, non staining clear cytoplasm. Finely granular eosinophilic scanty material was also present in some liver cells indicative of ballooning degeneration. Cell membranes wer distinct in majority of liver cells, but a few showed fraying or disruption. In addition, liver cell nuclei showed features of necrosis with smaller, condensed intensely basophilic round bodies (pyknotic), fragmentation (karyorrhexis) or complete loss of nuclei (anucleate). Acidophilic homogenous globular material was not observed. Kupffer cells were prominent. Focal infiltration of mononuclear cells in the sinusoids was occasionally present. Bile duct did not show any bile thrombi or any ductular proliferation.

Reticulin staining of the liver shows closing up of the central veins and fine scarring in and around the central vein (Fig. 8).

With lower doses of the toxicant, the ballooning degeneration was mostly around the majority of the congested central vein but changes were minimal or absent around the portal vein. With higher doses, the liver changes extended throughout the lobule but varied in intensity being most severe in centrilobular regions near terminal hepatic venules, but were also evident around the protal vein (Figs. 2 to 7).

Kidney : Kidney was mildly increased in size. The glomerular tufts were swollen and encroached Bowman's space. There was higher proportion of open capillary lumen containing plenty of RBC indicating congestion of the tuft. (Figs. 9 & 10).

Table 1 – Schedule of exposure to selenium salts.

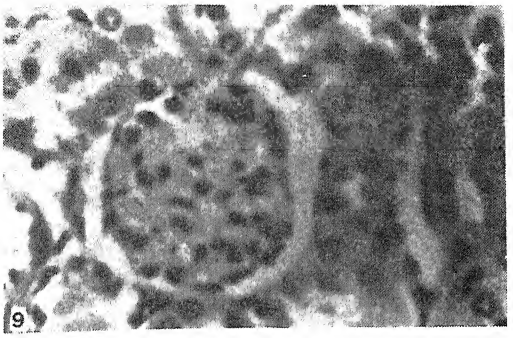
Chemicals used	Conc. (mg/kg bw)	Fraction of LD_{50}	Period of exposure (h)
Sodium selenite (Na_2SeO_3)	7, 14, 21, 28	1/8, 1/4, 1/3, 1/2	24
Sodium selenate	7, 14, 21, 28	1/10, 1/5, 3/10, 2/5	

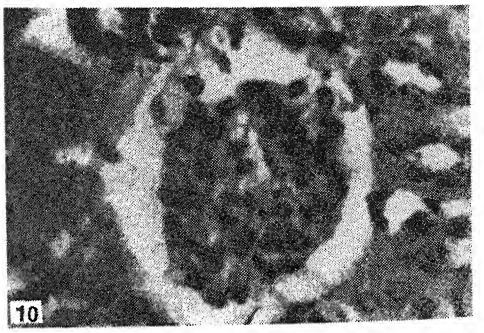
Six male mice were used per treatment set.

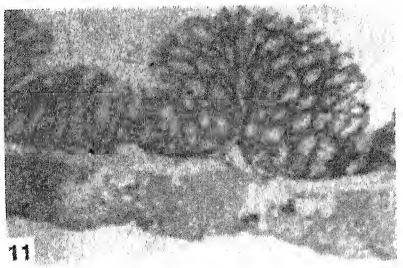
Stomach : Stomach showed focal erosion and hyperemia of the surface mucosa. The superficial gastric glands were desquamated, fragmented with loss of configuration and necrosis of its lining epithelium. There was exfoliation of the epithelial cells into the surface exudate. (Figs. 11-13).

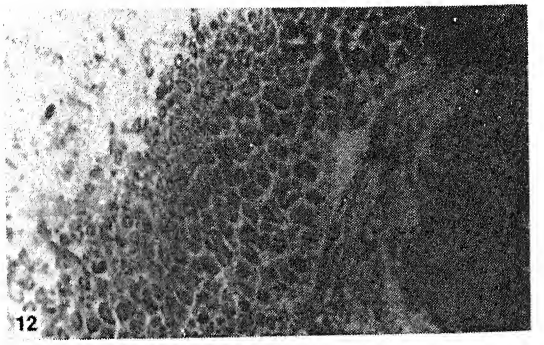
Inorganic selenium salts at higher doses give rise to toxic manifestations to both man and animals[6]. Severity of selenium poisoning depends on the species of animal, routes of administration and on the chemical forms of the element. The soluble selenium salts appear to be more toxic[8]. Histological reports on the effects of high doses on acute selenium (sodium selenite and sodium selenate) toxicosis following administration in mice is scanty and reported in some domestic animals, dogs and rats[9-11]. Our observation on liver reveals diffuse coagulative necrosis (ballooning degeneration) which is most severe around centrilobular region near hepatic venules. This is in contrast to earlier report of focal necrosis and fatty degeneration[8,9]. Moreover, the association of perivenular coagulative necrosis bears an analogy with the drug induced liver damage. Thus the changes are strongly indicative of selenium as hepatotoxic agent at high doses. It is possible that liver plays a significant role in the metabolism of selenium and changes may be due to differences in oxygenation and resultant anoxia and the activity of drug metabolizing enzyme[12]. In the kidney, congestion has been observed in agreement with the previous reports[9-11]. In stomach, corrosive gastritis has been observed which has not been reported earlier. Pathological changes in the different target organs showed dose dependent increase in their effects. The differences in histological changes between the two salts when given in same concentration are more or less similar. No obvious difference was possible to assess on cytomorphology. It may be possible that two salts are similarly metabolised in the test system. Thus, the results obtained from our *in vivo* studies of selenium establish an almost complete xenobiotic target organ map.

The author is grateful to Prof. A. Sharma, Emeritus Scientist, Centre of Advanced Studies in Cell and Chromosome Research and to Dr. (Mrs.) G. Talukder, Dean, V.I.M.S. for their guidance. The author thank Prof. K.P. Sengupta, Ex-Director, I.P.G.M.R. and Prof. S.K. Biswas, Senior consultant Pathologist for their constant encouragement, helpful discus-









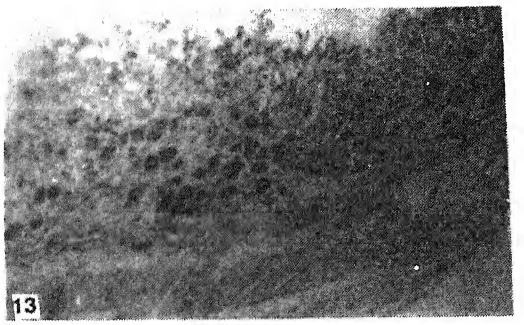


Fig. 9 – Kidney shows swelling and congestion of the glomerular tufts encroaching the Bowman's space. Mice orally treated with 21 mg/kg bw of sodium selenite. (ca × 450).

Fig. 10 – Section of Kidney having increase in size of glomerular tufts with plenty of RBC. Mice orally treated with 28 mg/kg bw of sodium selenate (ca × 450).

Fig. 11 – Section shows normal villus structure of surface epithelium of stomach. The mucosa consists of glands containing large number of mucosa secreting goblet cells (ca × 60).

Fig. 12 – Stomach shows necrosis of the surface mucosal epithelium and fragmentation of gastric glands in mice treated with sodium selenite, 14 mg/kg bw (ca × 60).

Fig. 13 – Section of stomach after exposure to sodium selenate shows erosion of the surface mucosa with desquamation and fragmentation of gastric glands in mice treated with 21 mg/kg bw of sodium selenate (ca × 60).

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Bionomics of Glasshouse whitefly *Trialeurodes vapororium* (Westhood) and its management

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Abstract Bionomics of *T. vapororium* was studied in the glasshouses at Shimla and it was observed that tomato and potato plants are most preferred hosts for colonizing. Of the various insecticides tested at varying doses Bacillus thuringiensis formulation Dipel @0.02%, Monocrotophos @0.04% and metasystox (Methyl-s-Dematon) @0.03% gave significant control of the pest upto 15 days after spraying the plants with the chemicals.

(**Keywords** : bionomics/feeding/*Trialeurodes vapororium*)

Whitefly *T. vapororium* in recent years has become the major pest on the glasshouse planted potato and other ornamental and vegetable crops (Salazer, 1996). It has also been reported as the vector of potato yellow vein disease from Colombia (Tamayo and Navarro, 1984). Realising its importance on potato crop, systematic studies were carried out at Central Potato Research Institute, Shimla to workout its bionomics and suitable management strategies.

The bionomics of whiteflies was studied on potato and other alternate host plants in the glasshouse. It was observed that whiteflies feed and colonise on large variety of host plants the important ones are tomato, tobacco, capsicum, amaranthus, brinjal, cabbage and potato. Of these tomato and potato plants were found most preferred as Whitefly population on these plants recorded between 49 and 107 nymphs or adults per plant during warmer months *i.e.* April to September when minimum and maximum temperatures inside glass house ranged between 20.0° and 35.6°C. However during cooler months, i.e. October to March its population ranged between 0–18 per plant when minimum and maximum temperatures ranged between 5° to 16°C.

In a replicated pot experiment conducted in the glass house during June month efficacy of six different pesticides were evaluated. The pesticides included in the trial were Cypermethrin @ 0.001%, DDVP @ 0.05%, Hostathion @ 0.05%, Monocrotophos @ 0.06% Methyl –s-Dematon @ 0.03% and Dipel-a commercial formulation of B.T. @ 0.04%. The effectiveness of tested pesticides was evaluated by recording the population of whiteflies per plant per replicate at the time of spraying and after 2, 5 and 10 days of spraying. The data on the average Whitefly population per plant per treatment are

Table 1 – Management of White fly in Glasshouses.

	Treatment	AVERAGE NUMBER OF WHITEFLY PER REPLICATE (Figures in parenthesis are square root transformations of the original value)				
		0	2	5	10	15
1.	Control	39.0 (5.764)	56.6 (6.632)	53.0 (6.378)	56.6 (6.656)	48.4 (5.875)
2.	Methyl-S Demeton @ 0.025%	24.6 (4.414)	15.6 (3.526)	16.8 (3.689)	17.6 (3.6662)	25.4 (4.091)
3.	Methyl-S- Demeton @0.03%	31.8 (4.751)	13.8 (3.455)	9.2 (2.962)	5.8 (2.348)	12.6 (2.871)
4.	Methyl-S- Demeton @ 0.035%	21.8 (4.315)	8.0 (2.451)	4.4 (1.946)	3.0 (1.658)	5.8 (1.989)
5.	Monocroto -phos @0.04%	32.2 (5.142)	6.6 (2.418)	3.6 (1.929)	4.2 (1.960)	5.2 (2.105)
6.	Monocroto -phos @0.05%	18.0 (3.924)	6.8 (2.298)	4.6 (2.143)	3.0 (1.725)	3.0 (1.725)
7.	Monocroto -phos @0.06%	17.6 (4.042)	1.4 (1.367)	2.0 (1.546)	2.6 (1.656)	1.8 (1.475)
8.	B.t. @ 0.02%	19.8 (2.304)	10.2 (1.599)	6.8 (1.133)	8.2 (1.463)	5.6 (1.176)
9.	B.t. @0.03%	19.2 (2.555)	13.0 (2.473)	13.0 (2.329)	16.0 (3.107)	10.6 (2.346)
10.	B.t. @ 0.04%	25.6 (4.249)	6.6 (2.288)	9.4 (2.582)	10.6 (2.655)	15.8 (3.237)

ANOVA :

C. factor · 2545.975 c.v. 69.00%

Sources of variation	Df	s.s.	Ms	F value	F. prob.
Treatment	9	321.78	35.75	7.37	0.000
Days	4	99.43	24.85	5.13	0.00059
Treatment x days	36	51.883	1.44	0.30	0.99997
Error (B)	200	969.9	4.84		
Critical Difference	1.228				

Control of White Flies in glass houses of Shimla by various Insecticides

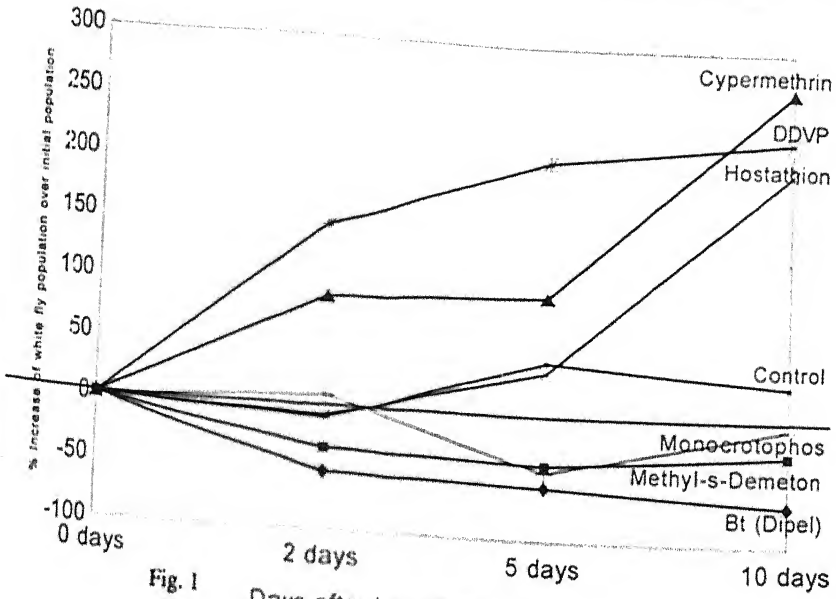

Fig. 1

LSD comparisons of various treatments (at 5% level) for management of white fly in glass houses

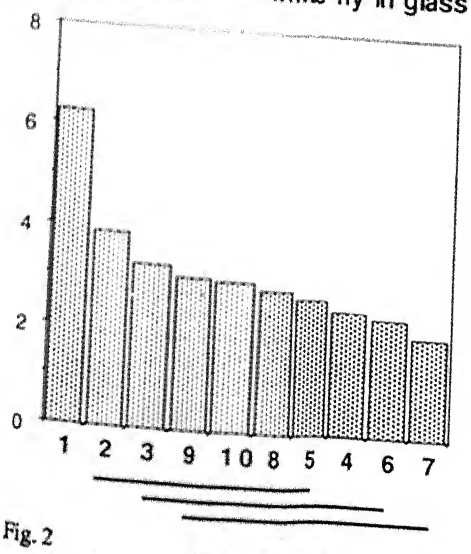

Fig. 2

presented in the figure 1. The data suggested that monocrotophos, Methyl–s-Dematon and B.T. treatments were good in checking multiplication of whiteflies on plants upto 10 days over their initial population.

Based on this result a detailed experiment was laid out in the month of April in the subsequent year, comparing various doses of the compounds foud effective earlier. Also, population was recorded upto 15 days post insecticide application. The treatments were Methyl-s-dematon @ 0.025, 0.03 and 0.035%, Monocrotophos @ 0.04, 0.05, 0.06%, Dipel (B.t) @ 0.02, 0.03 and 0.04% and population of Whitefly per replication was taken before spraying, at 2, 5, 10 and 15 days post spraying. Each treatment had five replications.

The data from this experiment was square root transformed and analysed whose results are presented on Table 1. Latin Square Design analysis of the above data, presented in Figure 2, clearly brings out the fact that there is a significant reduction in Whitefly population with these chemical sprays. The best results were obtained with Monocrotophos @ 0.06% concentration (treatment 7) while lower concentrations of Monocrotophos and B.T. (Dipel) gave equally good results. Methyl -s-Dematon was statistically effective only at its highest dose –0.035%. Hence we can conclude that spraying potato plants with 0.04% Monocrotophos or Dipel at 0.02% manages Whitefly population effectively.

Academy News

Science Communication Activities :

- **Extension lectures** were organised in several institutions in Satna (M.P.) and Phaphamau (a suburb of Allahabad) in October - November 2000 and in Mirzapur (U.P.) in February 2001. Speakers included Dr. D.K. Chauhan, Prof. Dilip Jatkar, Professor (Miss) D. Kaul, Professor H.C. Khare, Professor Vinod Prakash, Professor Suresh Chandra Srivastava, Professor U.S. Srivastava, Professor Krishna Swarup, and Dr. (Mrs) Sharda Sundaram.
- **Science Quizes, Debates, Orations and Exhibitions** were organized for local students in February 2001. The running trophy for Science Quiz was won by the students of St. Joseph's College.
- **U.P. State level Science Quiz, Debate, Oration and Exhibition** were organized in February 2001 in which about 150 students representing 24 districts of U.P. participated. The topics of the Debate and Oration respectively were "Information technology has added to social and economic disparity in the country" and "Contributions of Physical Sciences to the progress of Biological Sciences & Medical Sciences".
- **The Academy also coordinated an exhibition** organized by the Department of Biotechnology, Govt. of India, at the Mahakumbh Mela from 15th January to 10th February, 2001. A very large number of Kalpavasis, pilgrims and citizens of Allahabad witnessed the exhibition and benefitted from the exhibits.
- At the behest of Prof. H.C. Khare, General Secretary of the Academy, **a five-days comprehensive programme with the collaboration of the Vikram A. Sarabhai Community Science Centre, Ahmedabad** was held at Allahabad on February 23-27, 2001 under the enthusiastic guidance of Dr. B.R. Sitaram, Director of the Centre alongwith the state level activities, so that the benefit of the same could be made available to students and teachers coming from various districts of U.P., besides those from Allahabad. The programme included-

(a) Interactive Science Exhibition for students;

(b) Demonstrations in Physics and Mathematics;

(c) 5-days Workshop for teachers for preparing low cost science teaching aids to be used in school teaching. Twenty eight teachers from 15 districts of U.P. participated in this workshop. Participating teachers assured that they would try to organise local/district level workshops to disseminate whatever they have learnt here. The Academy has assured them of all cooperation and assistance.

(d) Demonstration of making paper aeroplanes accompanied with lectures on principles of aerodynamics in which a large number of students and citizens participated.

- **Science Day Function** on Feberuary 28, 2001 was presided over by Prof. S.K. Joshi, President of the Academy. Prof. N.K. Sanyal, Vice-Chancellor, Rajarshi Tandon Open University, Allahabad was the Chief Guest. A large nubmer of students, teachers and distinguished citizens were present on the occasion.

Prof. S.K. Joshi, President of the Academy, presented the National Academy of Sciences, India – Science Teacher Award to Dr. Deepak Sharma of N.A.S. Inter College, Meerut. Prof. Joshi highlighted the importance of the Academy's Science Communication Programmes as tools for cultivataing scientific temper in the society and stimulating students and teachers to be involved in doing good science and opt for it as a career. The country, he said can progress only when S&T progresses. He assured that the Academy will undertake more such activities in the pursuit of its objective.

Prof. Sanyal gave away prizes to the students. Prof. Sanyal called upon young students to study science in the true spirit and derive inspiration from the great scientists our country has produced. Dr. B.R. Sitaram while giving Certificates to the teachers who participated in the Teachers Workshop expressed his appreciation for the initiatives taken by the Academy in providing a conducive attitude in teaching and learning science among school teachers and students and assured cooperation by the VASCSC, Ahmedabad in future also.

Prof. H.C. Khare, General Secretary, proposed a vote of thanks to all concerned especially to Dr. B.R. Sitaram who readily agreed to his request to visit Allahabad along with his team to conduct this programme.

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